Docket No. 245941US6

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF: Bruno BENEDETTI, et al. GAU:

SERIAL NO: New Application EXAMINER:

FILED: Herewith

FOR: TURBINE BLADE

REQUEST FOR PRIORITY

COMMISSIONER FOR PATENTS
ALEXANDRIA, VIRGINIA 22313

SIR:

☐ Full benefit of the filing date of U.S. Application Serial Number , filed , is claimed pursuant to the provisions of **35 U.S.C. §120**.

☐ Full benefit of the filing date(s) of U.S. Provisional Application(s) is claimed pursuant to the provisions of **35 U.S.C. §119(e)**: **Application No.** **Date Filed**

■ Applicants claim any right to priority from any earlier filed applications to which they may be entitled pursuant to the provisions of **35 U.S.C. §119**, as noted below.

In the matter of the above-identified application for patent, notice is hereby given that the applicants claim as priority:

COUNTRY	APPLICATION NUMBER	MONTH/DAY/YEAR
Great Britain	0228066.7	December 2, 2002

Certified copies of the corresponding Convention Application(s)

■ are submitted herewith

☐ will be submitted prior to payment of the Final Fee

☐ were filed in prior application Serial No. filed

☐ were submitted to the International Bureau in PCT Application Number
Receipt of the certified copies by the International Bureau in a timely manner under PCT Rule 17.1(a) has been acknowledged as evidenced by the attached PCT/IB/304.

☐ (A) Application Serial No.(s) were filed in prior application Serial No. filed ; and

☐ (B) Application Serial No.(s)

☐ are submitted herewith

☐ will be submitted prior to payment of the Final Fee

Respectfully Submitted,

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The Patent Office
Concept House
Cardiff Road
Newport
South Wales
NP10 8QQ

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

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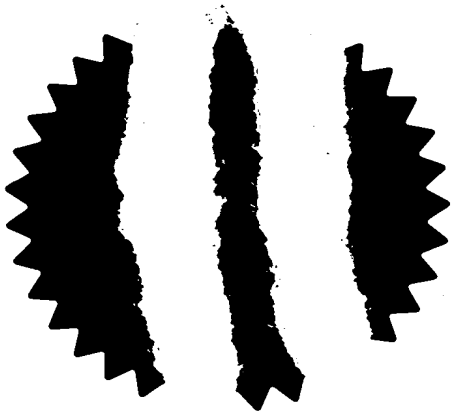

Signed K Behen

Dated 18 September 2003

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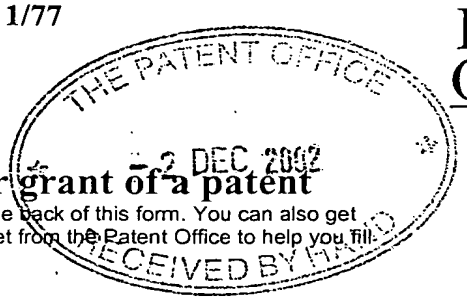
Patents Act 1977
(Rule 16)



The Patent Office

030EC02 E767929-1 D03312
P01/7700 0.00-0228066.7

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

0 2 DEC 2002

The Patent Office

Cardiff Road
Newport
Gwent NP9 1RH

1. Your reference GBP86831

2. Patent application number
(The Patent Office will fill in this part) 0228066.7

3 Full name, address and postcode of the or of each applicant (underline all surnames)

ALSTOM (Switzerland) Ltd,
Brown Boveri Strasse 7/699/5
CH-5401 Baden
Switzerland

02 5718005

Patents ADP number (if you know it)

If the applicant is a corporate body, give the country/state of its incorporation Switzerland

4. Title of the invention TURBINE BLADE WITH COOLING BORES

5. Name of your agent (if you have one)
"Address for service" in the United Kingdom to which all correspondence should be sent
(including the postcode)

Marks & Clerk
57 - 60 Lincolns Inn fields
London WC2A 3LS

Patents ADP number (if you know it) 18001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number

Country	Priority application No (if you know it)	Date of filing (day / month / year)

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing (day / month / year)

8. Is a statement of inventorship and of right to grant of a patent required in support ofthis request? (Answer 'Yes' if:
a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d)) Yes

Patents Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	0
Description	4
Claim(s)	2
Abstract	1
Drawing(s)	4+4

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent (Patents Form 7/77)	1
Request for preliminary examination and search (Patents Form 9/77)	1
Request for substantive examination (Patents Form 10/77)	
Any other documents (please specify)	

11. I/We request the grant of a patent on the basis of this application.

Signature Marks & Clerk Date: 2 December 2002

12. Name and daytime telephone number of person to contact in the United Kingdom

GB Patent Filings
0207 400 3000

M&C Folio: GBP86831
B02/110-GB

Document : 868719

TURBINE BLADE WITH COOLING BORES

This invention relates to turbine blades, both guide blades and moving blades, for gas turbines.

An example of a turbine blade according to the prior art is shown in Figures 1 and 2 of the accompanying drawings. The turbine blade 1 has a blade body or airfoil 2 extending from an outer platform 3 to an inner platform 4. The airfoil 2 is hollow and receives a gaseous coolant (e.g. air), which is discharged from holes 6 in the trailing edge. The interior of the airfoil 2 also communicates with the pressure side 8 and suction side 9 of the airfoil through rows of holes 11 so that the outside of the airfoil is cooled by a film which forms on the surface. Similar rows of holes 12 are formed in the platforms 3, 4. The turbine blade is made by casting and there is a smooth transition or filet 13 between each of the pressure and suction sides 8, 9 of the airfoil 2 and each of the platforms 3, 4.

For efficient cooling of the filets 13, groups 14 of film cooling holes are provided at several positions along each filet. However, these additional holes increase the amount of gaseous coolant which has to be supplied to the turbine blade 1.

It would therefore be desirable to be able to enhance the cooling of a filet and reduce the number of holes required for this purpose.

The present invention provides a turbine blade for a gas turbine, comprising a hollow airfoil extending from a platform, there being a filet between the airfoil and the platform on the pressure side or the suction side of the airfoil, the filet containing a cooling bore extending along part of the length of the filet, the cooling bore having a first end communicating with the interior of the turbine blade for receiving a gaseous coolant, and a second end communicating with the exterior of the turbine blade.

The cooling bore may be straight or curved, preferably with a substantially constant radius of curvature.

The invention also provides a method of manufacturing the turbine blade, including forming the cooling bore by electro-discharge machining (EDM).

The invention will be described further, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of a known type of turbine blade according to the prior art;

Figure 2 is a cross-section through the airfoil of the known turbine blade, viewing towards the outer platform;

Figure 3 shows an embodiment of a turbine blade according to the present invention, viewed from the pressure side;

Figure 4 is a section on line IV-IV in Figure 3;

Figure 5 shows the turbine blade of Figure 3, viewed from the outside of the outer platform;

Figure 6 is a section on line VI-VI in Figure 5;

Figure 7 is a section on line VII-VII in Figure 5; and

Figure 8 is a fragmentary perspective view showing part of the exit side of the turbine blade, including part of the trailing edge of the airfoil.

The turbine blade shown in Figures 3 to 8 is similar in structure to the turbine blade 1 shown in Figures 1 and 2, and similar parts are given the same reference numerals. The film cooling holes 11 and 12 in the blade body or airfoil 2 are present but are not shown in Figures 3 to 8, whereas the groups 14 of film cooling holes in the prior art turbine blade are not present in the preferred embodiment of the turbine blade according to the present invention. It will be noted that the interior of the platform 3 is provided with protuberances 16 for enhancing internal cooling (Fig. 5).

On the pressure side 8 the filet 13 between the airfoil 2 and the outer platform 3 has a cooling bore 17 (see particular Figure 7) which is approximately 55 mm long and which has a first end 17a communicating with the interior of the platform 3 and a second end 17b communicating with the exterior of the turbine blade 1 at the exit side, adjacent the trailing edge 7 of the airfoil 2. Similarly, on the suction side 9 the filet 13 contains a cooling bore 18 (see particularly Figure 6) extending for approximately 75 mm along the filet and having a first end 18a communicating with the interior of the platform 3 and a second end 18b communicating with the exterior of the turbine blade, adjacent the trailing edge 7. Each cooling bore 17, 18 has a diameter of 1 ± 0.1 mm, for example.

The cooling bores 17, 18 are preferable formed in the turbine blade casting by a high speed EDM machine, using a single point rotary EDM tool. Taking account of the casting tolerances, the cooling bores 17, 18 are positioned so that their exit ends 17b, 18b are exactly at the desired position. The machining of each cooling bore is preferably commenced at the exit side of the turbine blade and is terminated after the bore has reached the interior of the platform 3 such that a groove (17c, 18c) is formed in the platform.

The cooling bores 17, 18 extending along the filets 13 can provide approximately the same cooling effect as a multiplicity of film cooling holes, thereby saving a substantial amount of gaseous coolant.

Various modifications may be made within the scope of the invention. For example, similar cooling bores extending along the filets 13 could be provided at other locations, in addition to or instead of the bores 17, 18. Also, the provision of film cooling holes in or near the filet 13 is not precluded. It may be possible for the cooling bore to have a diameter as small as about 0.5 mm or as large as 2 mm or more. The cooling bore will normally have a length of several centimetres, preferably at least 5 cm, the maximum length being limited by practical considerations and possibly being 10 cm or more.

Although the cooling bores have been described only in connection with the filets between the airfoil and the outer platform, similar cooling bores could be provided on the filets between the airfoil and the inner platform.

CLAIMS:

1. A turbine blade for a gas turbine, comprising a hollow airfoil extending from a platform, there being a filet between the airfoil and the platform on the pressure side or the suction side of the airfoil, the filet containing a cooling bore extending along part of the length of the filet, the cooling bore having a first end communicating with the interior of the turbine blade for receiving a gaseous coolant and a second end communicating with the exterior of the turbine blade.

2. A turbine blade as claimed in claim 1, in which the first end of the cooling bore is inside the platform.

3. A turbine blade as claimed in claim 1 or 2, in which the second end of the cooling bore is at the exit side of the turbine blade.

4. A turbine blade as claimed in any of claims 1 to 3, in which the second end of the cooling base is adjacent the trailing edge of the airfoil.

5. A turbine blade as claimed in any of claims 1 to 4, in which the cooling bore is straight.

6. A turbine blade as claimed in any of claims 1 to 4, in which the cooling bore is curved.

7. A turbine blade as claimed in claim 6, in which the cooling bore has a substantially constant radius of curvature.

8. A turbine blade as claimed in any preceding claim, in which the cooling bore has a diameter of approximately 1 mm.

9. A turbine blade as claimed in any preceding claim, in which the cooling bore has a length of at least 5 cm.

10. A turbine blade as claimed in any preceding claim, in which there are two said cooling bores, one in the filet on the pressure side and the other in the filet on the suction side.

11. A method of manufacturing a turbine blade according to claim 1, including forming the cooling bore by electro-discharge machining.

12. A method as claimed in claim 11, in which the machining of the cooling bore is commenced at the exit side of the turbine blade.

13. A method as claimed in claim 12, in which the machining of the cooling bore is terminated after the bore has reached the interior of the platform such that a groove is formed in the platform.

14. A turbine blade substantially as described with reference to, and as shown in, Figures 3 to 8 of the accompanying drawings.

15. A method of manufacturing a turbine blade, substantially as described with reference to Figures 3 to 8 of the accompanying drawings.

ABSTRACT:

TURBINE BLADE WITH COOLING BORES

A turbine blade for a gas turbine has a hollow airfoil 2 extending from a platform 3. There is a filet between the airfoil 2 and the platform 3, both on the pressure side and on the suction side of the airfoil. The filet contains a cooling bore 17 or 18 extending along part of the length of the filet, having a first end 17a or 18a communicating with the interior of the turbine blade for receiving a gaseous coolant and a second end 17b or 18b communicating with the exterior of the turbine blade. The cooling bore may be formed by EDM.

(Fig. 5)

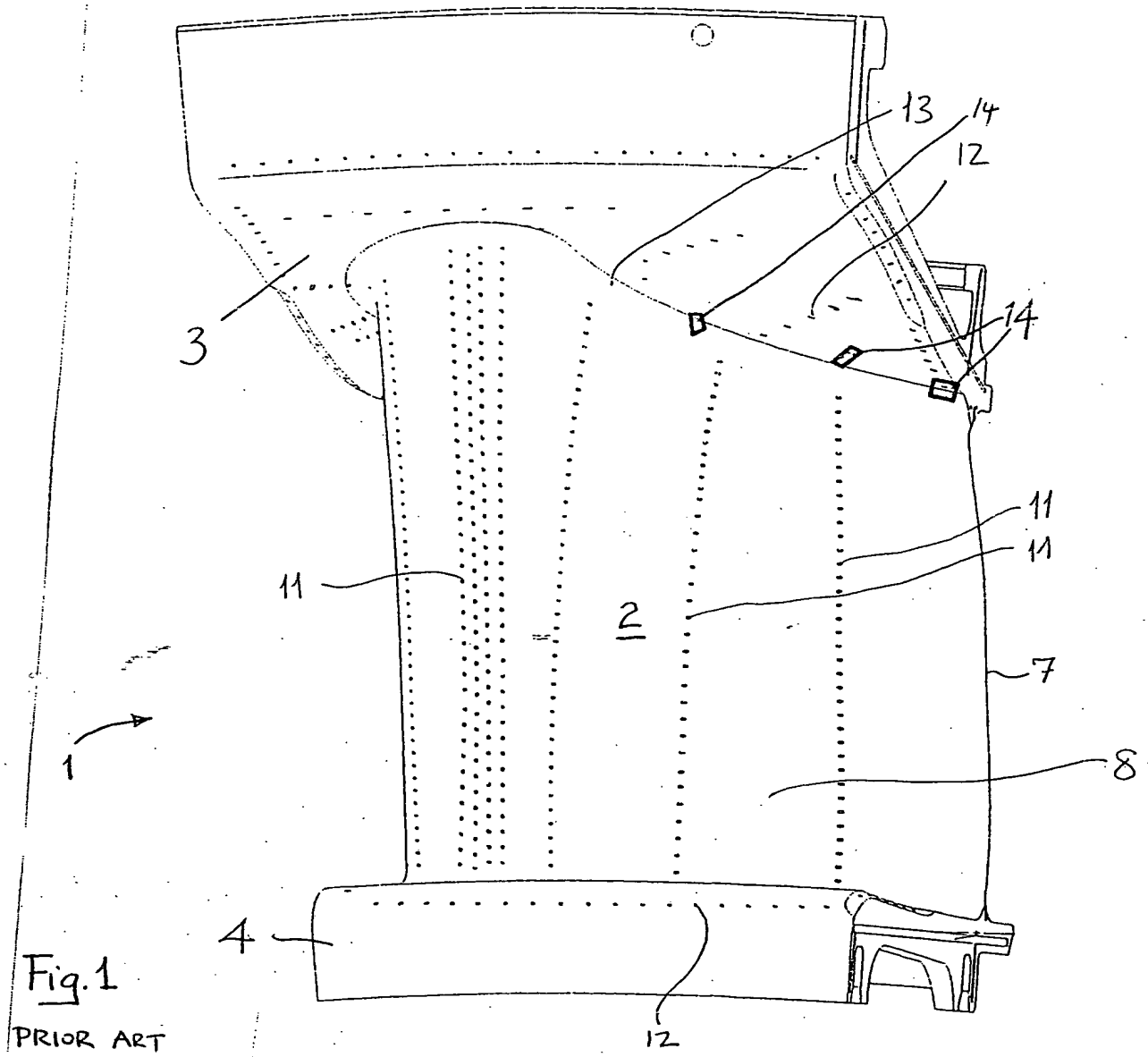


Fig.1
PRIOR ART

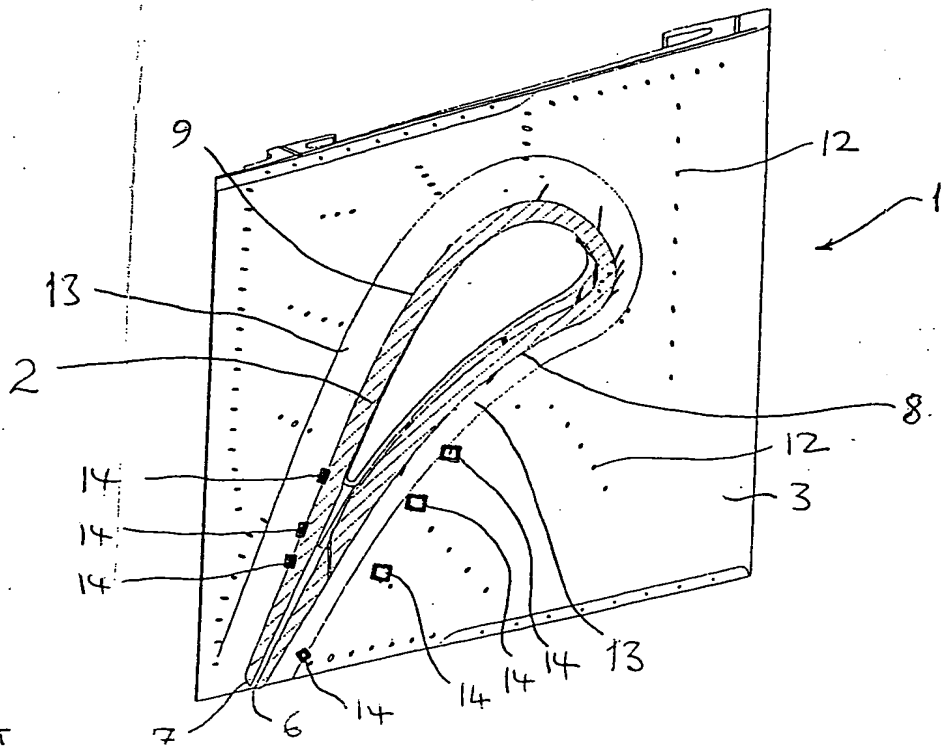


Fig.2
PRIOR ART

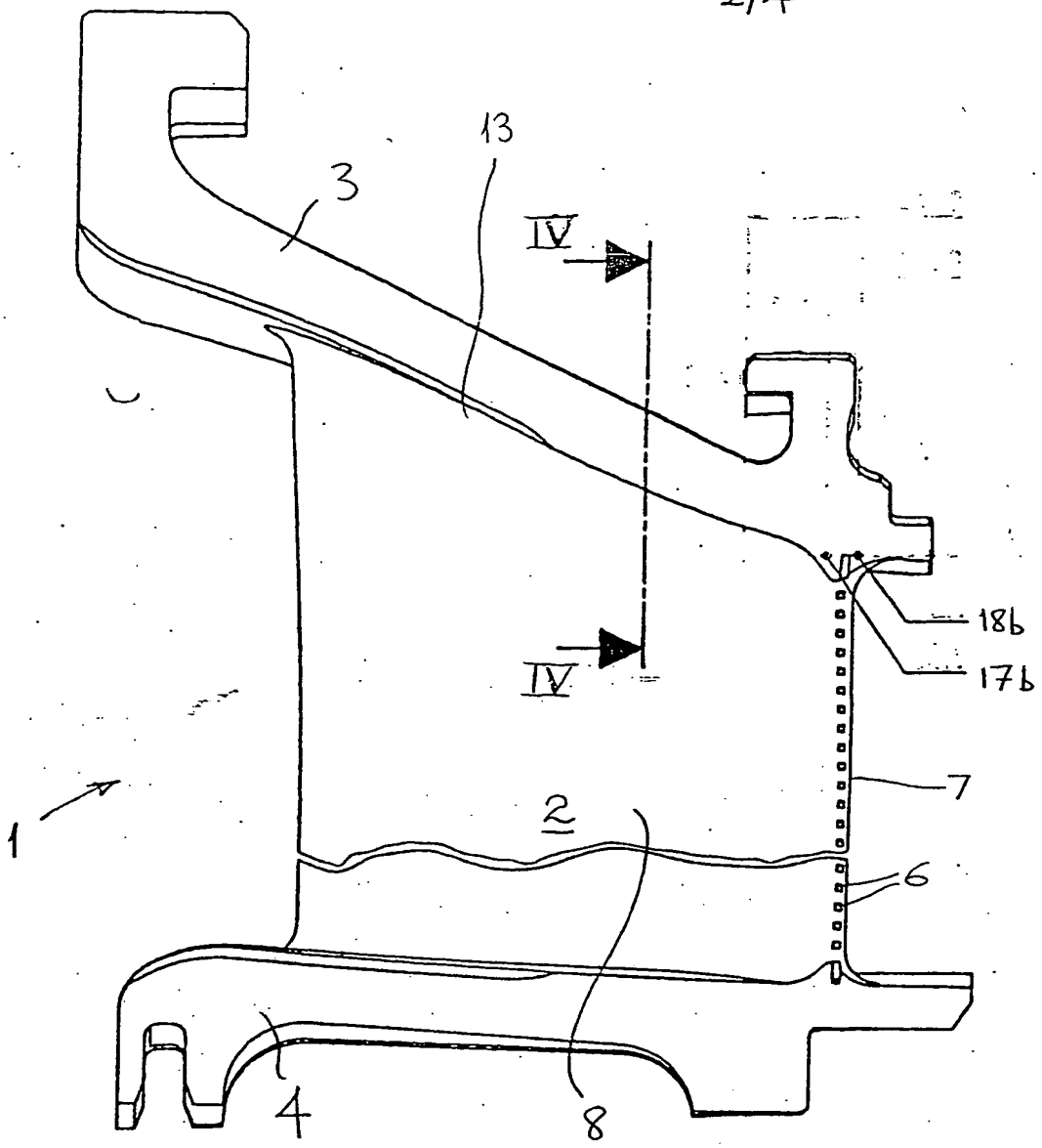


Fig. 3

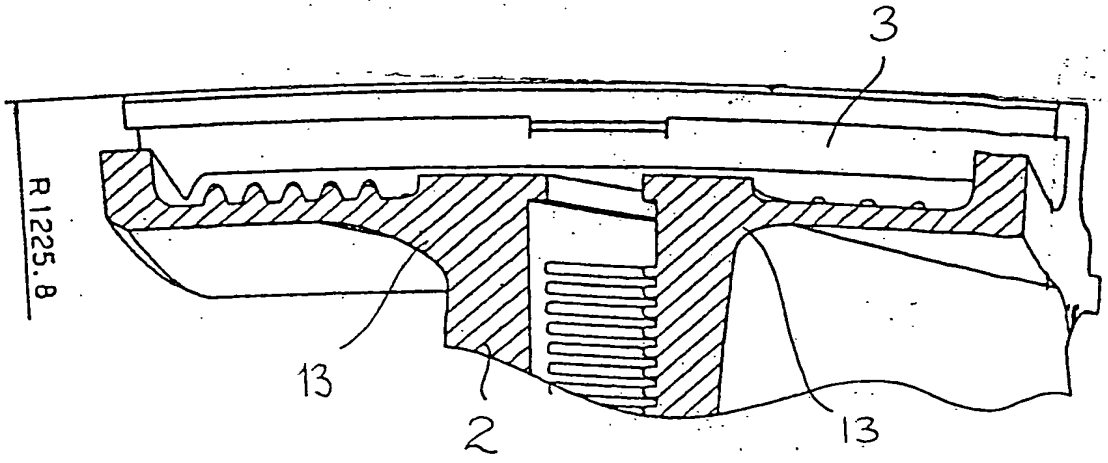


Fig. 4

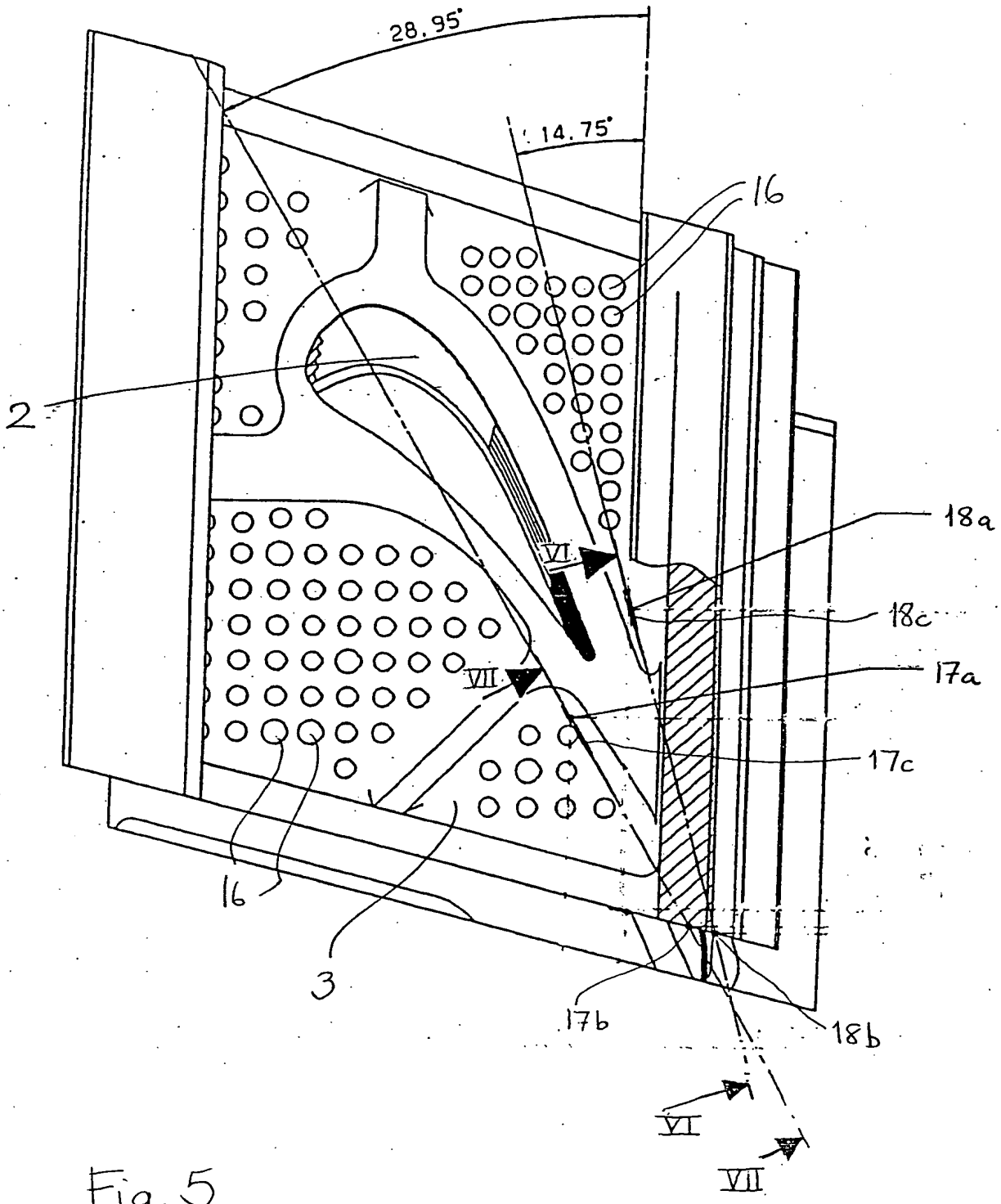


Fig. 5

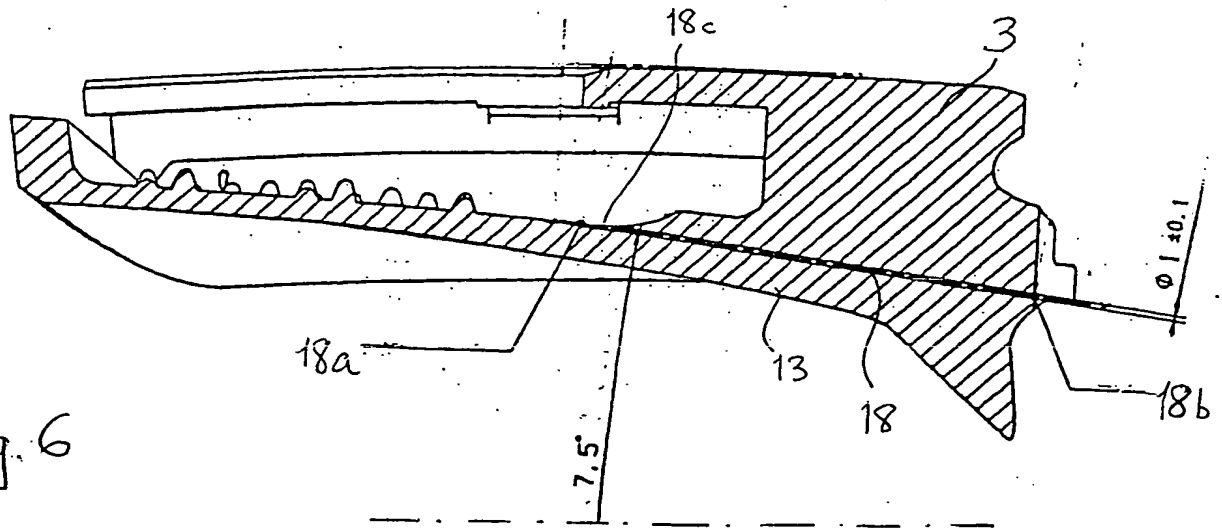


Fig. 6

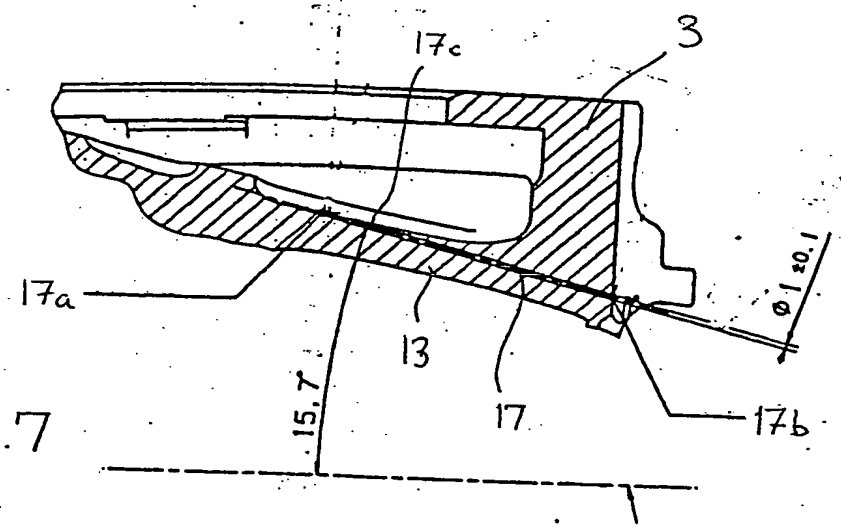


Fig. 7

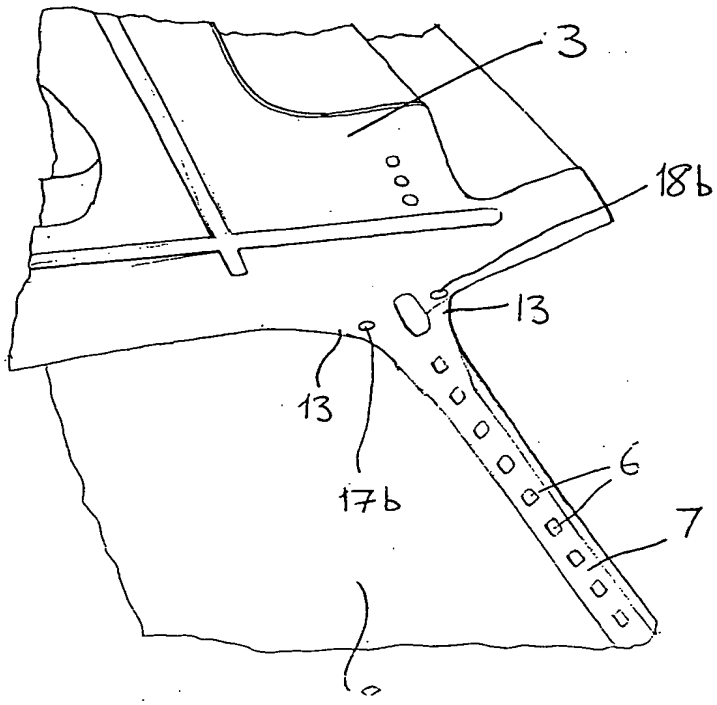


Fig. 8

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